IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of: **Shannon, et al.**	§	Serial No.: **10/823,364**
Filed: **April 12, 2004**	§	Confirmation No.: **4844**
Docket No.: **APPM/8756/ETCH/DICP**	§	Group Art Unit: **1792**
For: **Plasma Control Using Dual Cathode Frequency Mixing**	§	Examiner: **Angadi, Maki A.**

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

SUPPLEMENTAL REPLY BRIEF

In response to the Examiner's Answer dated on December 31, 2008, the Appellants hereby submit this Supplemental Reply Brief to the Board of Patent Appeals and Interferences. Specifically, this Supplemental Reply Brief is submitted to address differing responses made by the Examiner between the Examiner's Answer dated April 18, 2008 and the Examiner's Answer date December 31, 2008 particularly regarding rejections of claims 34-35, 37-39 and 43-46. This Supplemental Reply Brief otherwise is substantively identical to the prior-filed, Reply Brief dated June 18, 2008.

The Appellants believe that no fees are due in connection with this submission. However, the Commissioner is hereby authorized to charge counsel's Deposit Account No. 50-3562 for any fees, including extension of time fees, required to make this response timely and acceptable to the Office.

REAL PARTY IN INTEREST

The real party in interest is Applied Materials, Inc., located in Santa Clara, California.

RELATED APPEALS AND INTERFERENCES

The Appellants know of no related appeal and/or interference that may directly affect or be directly effected by or have a bearing on the Board's decision in the pending appeal.

STATUS OF CLAIMS

Claims 1-14 and 33-46 are pending in the application. Claims 15-32 have been cancelled. Claims 1-14 and 33-46 stand rejected as discussed below. All rejections of claims 1-14 and 33-46 as set forth in the Office Action dated October 11, 2007, and as noted blow, are appealed. The pending appealed claims are shown in the attached Appendix.

STATUS OF AMENDMENTS

An amendment to claim 12 was submitted in this application subsequent to final rejection. In the Advisory Action dated March 29, 2007, the Examiner indicated that the amendment would not be entered. Accordingly, the argument presented below with respect to claim 12 reflects the claim as presented without such amendment.

SUMMARY OF CLAIMED SUBJECT MATTER

The present invention provides methods of controlling characteristics of a plasma in a semiconductor substrate etch processing chamber using a dual frequency RF source. In the embodiment of independent claim 1, a method of controlling characteristics of a plasma (110) in a semiconductor substrate etch processing chamber (100) using a dual frequency RF source (122, 123) includes supplying a first RF signal to a first electrode (127) disposed in an etch chamber (102); and supplying a second RF signal to the first electrode (127), wherein an interaction between the first and second RF signals is used to control at least one characteristic of a plasma (110) formed in the

etch chamber. (*See, e.g., Specification*, ¶¶[0015]-[0016], [0019], [0023], [0029]-[0031]; Figs. 1, 3.)

In the embodiment of independent claim 34, a method of controlling characteristics of a plasma in a semiconductor substrate etch chamber using a dual frequency RF source includes determining a desired energy distribution of the plasma (110); and producing the desired energy distribution through a controlled interaction between a first and a second RF signal applied to a first electrode (127) disposed in an etch chamber (102). (*See, e.g., Specification*, ¶¶[0015]-[0016], [0019], [0023], [0034]-[0035]; Figs. 1, 4.)

In the embodiment of independent claim 37, a method of controlling characteristics of a plasma in a semiconductor substrate etch chamber using a dual frequency RF source includes supplying a first RF signal at a first power level to a first electrode (127) disposed in an etch chamber (102); and controlling the application of a second RF signal at a second power level to the first electrode (127) to produce a desired power distribution in the plasma. (*See, e.g., Specification*, ¶¶[0015]-[0016], [0019], [0023], [0034]-[0035]; Figs. 1, 4.)

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Claims 1-3 and 10 stand rejected under 35 USC. §103 as being unpatentable over U.S. Patent Application Publication No. 2003/0127319 to *Demaray, et al.* (hereinafter *Demaray*).

2. Claims 40-42 stand rejected under 35 USC §103 as being unpatentable over *Demaray*, as applied to claim 1 above, in further view of U.S. Patent Application Publication No. 2003/0148611 to *Dhindsa et al*. (hereinafter *Dhindsa*).

3. Claims 4-9, 11 and 12 stand rejected under 35 USC §103 as being unpatentable over *Demaray*, as applied to claims 1-3, and 10 above, and in further view of *Georgieva et al.,* Journal of Applied Physics, V. 94, No. 6, Sept. 15, 2003, pgs 3748-3756 (hereinafter *Georgieva*).

4. Claim 13 stands rejected under 35 USC §103 as being unpatentable over *Demaray* in view of *Georgieva*, as applied to claims 10-12 above, and in further view of

Lieberman et al. (Plasma Sources Sci. Technol., 11 (2002), pages 283-293) (hereinafter *Lieberman*).

5. Claim 33 stands rejected under 35 USC §103 as being unpatentable over *Demaray*, as applied to claim 1 above, in view of *Georgieva* and *Lieberman*.

6. Claim 14 stands rejected under 35 USC §103 as being unpatentable over *Demaray* in view of *Georgieva*, as applied to claims 10-12, and in further view of *Dhindsa*.

7. Claims 34-35 and 37-39 stand rejected under 35 USC §103 as being unpatentable over *Dhindsa* and *Lieberman*.

8. Claim 36 stands rejected 35 USC §103 as being unpatentable over *Dhindsa* in view of *Lieberman*, as applied to claim 34, and in further view of *Demaray* and *Georgieva*.

9. Claims 43-46 stand rejected under 35 USC §103 as being unpatentable over *Dhindsa* and *Lieberman.*

ARGUMENT

The following is provided solely in response to the comments made by the Examiner in the Response to Arguments section of the Examiner's Answer (*Examiner's Answer*, p.14-17.) The Appellant maintain all arguments and positions asserted in the prior-filed Appeal Brief in addition to any further comments and arguments made below.

1. 35 USC §103 Claims 1-3 and 10

The Appellants note that the Grounds for Rejection and Response to Arguments sections of the Examiner's Answer regarding Claims 1-3, and 10 are substantively identical to those of the prior Examiner's Answer dated April 18, 2008. Thus, the Appellants' reply regarding claims 1-3, and 10 is substantively identical to the reply provided in the Reply Brief dated June 18, 2008.

Claim 1

In the Response to Argument's section of the Examiner's Answer, the Examiner repeats his previous statement that "[i]n the plasma chamber the first and second frequency RF power signals are involved in a dynamic process to optimize the

characteristics of the plasma and hence the deposition or etch conditions." (*Examiner's Answer*, p.15.) The Examiner further places a citation to *Demaray* following this statement. (*Id.*, citing *Demaray,* ¶ [0043].) However, the Appellants point out that the prior statement is the Examiner's opinion and is not mentioned in the paragraph cited by the Examiner, nor anywhere else in *Demaray*.

The cited paragraph of *Demaray* discusses the use of dual frequencies for a PVD process and, in fact, and as previously admitted by the Examiner, teaches that each RF signal is utilized to provide independent benefits with respect to the disclosed process and not to control the any plasma characteristics through any combined interaction between the two frequencies. (*see, e.g., Office Action dated 10/11/07*, p. 8, ll. 8-10, "The higher frequency controls electron/ion density the lower frequency controls ion bombardment (through the sheath or DC potential) according to Demaray.")

The Examiner next asserts that *Demaray* discloses the benefit of using dual frequencies in the form of increased refractive index of the deposited film, (*Examiner's Answer*, p.15; citing *Demaray,* ¶ [0045]), and further asserts that the ratio of the first and second frequencies is a results effective variable which can be optimized for controlling plasma etching in Appellant's invention. The Appellants disagree.

In the paragraph cited by the Examiner, *Demaray* teaches that a dual frequency RF process can be used to deposit a core layer having a different refractive index than that of a cladding layer deposited by a single RF process. (*Demaray,* p. 5, ¶ [0045].) However, the Appellants point out that the present claims do not recite any limitations regarding controlling a refractive index of a deposited film or any other deposited film property.

Claim 1 recites, "wherein an interaction between the first and second RF signals is used to control at least one characteristic of a plasma formed in the etch chamber." *Demaray* fails to teach, suggest, or otherwise provides that any interaction exists between the first and second RF signals applied to the target – *Demaray* merely discloses that each signal is utilized to provide independent benefits in the disclosed PVD process and is silent with respect to any effect that may occur due to any interaction between the two RF signals applied to the target.

Moreover, in addition to failing to teach or suggest that an interaction between the two RF signals may have an effect on the plasma, *Demaray* further and *a fortiorari* fails to teach, suggest, or otherwise yield that control of such an interaction may be utilized to control any characteristics of the plasma. As discussed above, *Demaray* teaches that each RF signal is utilized to provide independent benefits with respect to the disclosed process. In fact, the Examiner admits this teaching in prior Office Actions and in the Response to Arguments section of the Examiner's Answer. (*see, e.g., Examiner's Answer*, p. 15, ll. 1-5, "The high frequency accelerates electrons in the plasma, which is not effective at accelerating the much slower heavy ions in the plasma. Adding a low frequency, according to Demaray causes ions in the plasma to bombard the film being deposited on the substrate, resulting in sputtering and densification of the film.")

Accordingly, *Demaray* fails to teach, suggest, or otherwise yield a process wherein an interaction between the first and second RF signals is used to control at least one characteristic of a plasma formed in the etch chamber, as recited in claim 1. As such, a *prima facie* case of obviousness has not been established because *Demaray* fails to yield the limitations recited in claim 1. Thus, claim 1, and all claims depending therefrom, are patentable over *Demaray*.

Claim 2

With respect to claim 2, the Examiner apparently misinterprets the pending claims by asserting that the teachings of *Demaray* read on Appellants' claim "where the dual frequency causes a sheath modulation." (*Examiner's Answer*, p. 4, citing *Demaray* ¶¶ [0043] and [0047].) The Appellants noted this and responded in the Appeal Brief accordingly. (*Appeal Brief*, p. 7., "claim 2 does not recite that the dual frequency causes a sheath modulation, as asserted by the Examiner. Claim 2 further limits claims 1 by reciting, 'wherein the plasma characteristic [controlled by the interaction between the first and second RF signals] is at least sheath modulation.'")

The Appellants note that, in the Response to Arguments section of the Examiner's Answer, the Examiner fails to acknowledge or address the Appellant's

arguments regarding claim 2 made in the Appeal Brief and merely repeats his prior argument from the preceding Office Action, dated 10/11/07.

As such, a *prima facie* case of obviousness has further not been established with respect to claim 2 because *Demaray* fails to yield the limitations recited therein. Thus, claim 2 is further patentable over *Demaray*.

Claim 10

With respect to claim 10, the Examiner repeats his assertion from the Response to Arguments section of the Office Action dated 10/11/07 that paragraph [0043] of *Demaray* teaches to use the first and second RF frequencies and modulating the flow of charge carriers to control the power distribution in the plasma. The Examiner further asserts that the dual frequency interaction in an RF deposition process causes reduced surface roughness. (*Examiner's Answer,* pp. 15-16, citing *Demaray*, ¶¶ [0044], [0082]-[0083].)

However, with respect to the repeated assertion from the Office Action, the Appellants previously addressed this issue, noting that the cited portion of *Demaray* teaches applying a high frequency signal for sputtering the target and applying a low frequency signal to cause ions in the plasma to bombard the film being deposited on the substrate, and fails to teach, suggest, or otherwise yield an interaction between the first and second RF signals is used to control the power distribution in the plasma. The Examiner fails to show how *Demaray* teaches using an interaction between the RF signals to control the power distribution in the plasma. Thus, the Appellants maintain that *Demaray* fails to teach, suggest, or otherwise yield the limitation, wherein the plasma characteristic is at least a power distribution within the plasma, as recited in claim 10.

With respect to the assertion that the dual frequency interaction in an RF deposition process causes reduced surface roughness, the Appellants note that the Examiner has still not shown how *Demaray* teaches to utilize an interaction between two RF frequencies to control a power distribution in the plasma. The cited portion of *Demaray* teaches applying a dual frequency RF process comprising a high frequency signal for sputtering the target and applying a low frequency signal to cause ions in the

plasma to bombard the film being deposited on the substrate, wherein each frequency independently controls a characteristic of the plasma. *Demaray* further teaches that a process utilizing two frequencies can result in reduced surface roughness of the deposited film. However, *Demaray* does not teach or suggest that the surface roughness of the deposited film is controlled by the power distribution in the plasma. The Examiner further fails to provide any explicit reasoning for his assertion. Moreover, the present claims do not recite controlling the surface roughness or any other film property of a deposited film. As such, *Demaray* fails to teach, suggest, or otherwise yield a process wherein an interaction between the first and second RF signals is used to control at least one characteristic of a plasma formed in the etch chamber, wherein the plasma characteristic is at least a power distribution within the plasma, as recited in claim 10.

Accordingly, a *prima facie* case of obviousness has further not been established with respect to claim 10, as the cited reference fails to teach or suggest all the limitations recited in the claim. Thus, claim 10 is further patentable over *Demaray*.

Thus, the Appellants submit that claims 1-3 and 10, and any claims depending therefrom, are patentable over *Demaray*. Accordingly, the Appellants respectfully request that the rejection be withdrawn and the claims allowed.

2. 35 USC §103 Claims 40-42

The Appellants note that the Grounds for Rejection and Response to Arguments sections of the Examiner's Answer regarding Claims 40-42 are substantively identical to those of the prior Examiner's Answer dated April 18, 2008. Thus, the Appellants' reply regarding claims 40-42 is substantively identical to the reply provided in the Reply Brief dated June 18, 2008.

The Examiner does not address the Appellants' arguments related to claims 40-42 in the Response to Arguments section of the Examiner's Answer. As such, the Appellants maintain their prior unrebutted argument that modifying *Demaray* in the manner suggested by the Examiner would impermissibly change the principle of operation of *Demaray* and further make the apparatus unsuitable for its intended purpose. The Appellants further maintain their unrebutted argument that, while *Dhindsa*

may disclose certain apparatus and methods for controlling etch rate uniformity, *Dhindsa* fails to teach, suggest, or otherwise yield a modification of *Demaray* that would result in a method wherein an interaction between the first and second RF signals is used to control at least one characteristic of a plasma formed in the etch chamber, as recited in claim 1, from which claim 40 depends. As such, a *prima facie* case of obviousness has not been established with respect to claim 40, as the combination of the cited references fails to yield all the limitations recited in the claim.

Thus, claim 40, and claims 41-42, depending therefrom are patentable over *Demaray* in view of *Dhindsa*. Accordingly, the Appellants respectfully request that the rejection be withdrawn and the claims allowed.

3. 35 USC §103 Claims 4-9, 11 and 12

The Appellants note that the Grounds for Rejection and Response to Arguments sections of the Examiner's Answer regarding Claims 4-9, 11 and 12 are substantively identical to those of the prior Examiner's Answer dated April 18, 2008. Thus, the Appellants' reply regarding claims 4-9, 11 and 12 is substantively identical to the reply provided the Reply Brief dated June 18, 2008.

In the Response to Arguments section of the Examiner's Answer, page 16, the Examiner again merely repeats his arguments from the preceding Office Action, dated 10/11/07. The Examiner fails to acknowledge or address the Appellant's arguments regarding claims 4-9, 11 and 12 made in the Appeal Brief, dated 03/10/08, other than merely stating that they are, to the Examiner, unpersuasive and reasserting the previously presented arguments.

As such, as the Examiner has not addressed the arguments set forth in the Appeal Brief, the Appellants maintain their essentially unrebutted position that *Georgieva* fails to teach, suggest, or otherwise yield a modification to the teachings of *Demaray* that would yield the limitations recited in claim 1, and that, therefore, a *prima facie* case of obviousness has not been established.

Thus, the Appellants submit that claims 4-9 and 11-12 are patentable over *Demaray* in view of *Georgieva*. Accordingly, the Appellants respectfully request that the rejection be withdrawn and the claims allowed.

4. 35 USC §103 Claim 13, 33

The Appellants note that the Grounds for Rejection and Response to Arguments sections of the Examiner's Answer regarding claims 13 and 33 are substantively identical to those of the prior Examiner's Answer dated April 18, 2008. Thus, the Appellants' reply regarding claims 13 and 33 is substantively identical to the reply provided in the Reply Brief dated June 18, 2008.

In the Response to Arguments section of the Examiner's Answer, page 16, the Examiner again merely reasserts his arguments from the preceding Office Action, dated 10/11/07. The Examiner fails to acknowledge or address the Appellant's arguments regarding claims 13 and 33 made in the Appeal Brief, dated 03/10/08, other than merely stating that they are, to the Examiner, unpersuasive and reasserting the previously presented arguments.

As such, as the Examiner has not addressed the arguments set forth in the Appeal Brief, the Appellants maintain their essentially unrebutted position that *Lieberman* fails to teach, suggest, or otherwise yield a modification to the combination of *Demaray* in view of *Georgieva* that would yield the limitations recited in claim 1. Thus, a *prima facie* case of obviousness has not been established as the combination of the cited references fails to yield the limitations recited in the claims.

Thus, the Appellants submit that claims 13 and 33 are patentable over *Demaray* in view of *Georgieva* and *Lieberman*. Accordingly, the Appellants respectfully request that the rejection be withdrawn and the claims allowed.

5. 35 USC §103 Claim 14

The Appellants note that the Grounds for Rejection and Response to Arguments sections of the Examiner's Answer regarding claim 14 are substantively identical to those of the prior Examiner's Answer dated April 18, 2008. Thus, the Appellants' reply regarding claim 14 is substantively identical to the reply provided in the Reply Brief dated June 18, 2008.

The Examiner does not address the Appellants' arguments related to claim 14 in the Response to Arguments section of the Examiner's Answer. As such, the Appellants maintain their prior unrebutted argument that *Dhindsa* fails to teach, suggest, or

otherwise yield a modification to the teachings of the combination of *Demaray* and *Georgieva* in a manner that would yield the limitations recited in the claims, and that, therefore, a *prima facie* case of obviousness has not been established.

Thus, the Appellants submit that claim 14 is patentable over *Demaray* in view of *Georgieva* and in further view of *Dhindsa*. Accordingly, the Appellants respectfully request that the rejection be withdrawn and the claim allowed.

6. 35 USC §103 Claims 34-35 and 37-39

The Appellants note that the Grounds for Rejection section of the present Examiner's Answer regarding claims 34-35 and 37-39 has been changed from the Grounds for Rejection section in the prior Examiner's Answer dated April 18, 2008 to correspond to the Grounds for Rejection present in the Office Action dated October 11, 2007. Specifically, the Examiner rejects claims 34-35 and 37-39 in view of *Dhindsa* and *Lieberman*. However, in the text supporting the rejection, the Examiner continues to cite the teachings of *Demaray* as justification for the rejection of the claims. (*See, e.g., Examiner's Answer dated December 31, 2008,* p. 12.) This inconsistency persists in the Response to Arguments section of the present Examiner's Answer dated December 31, 2008, where the Examiner discusses claims 34-35 and 37-39 in view of *Demaray*. (*Id.*, p. 14.) Further, in another section of the Response to Arguments section the Examiner states "[t]he combined reference of *Dhindsa* and *Lieberman* meets the limitations of these claims" referring to claims 34-35 and 37-39. (*Id.*, p. 16.) The Examiner then continues to state "[t]herefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to further improve the method of *Demaray* and *Dhindsa*....." (*Id.*, pp. 16-17.) Thus, the Appellants have responded below presuming that claims 34-35 and 37-39 are rejected in view of *Dhindsa*, *Lieberman*, and *Demaray* as explicitly argued by the Examiner in the Grounds for Rejection and Response to Arguments section of the Examiner's Answer dated December 31, 2008.

In the Response to Arguments section of the Examiner's Answer, page 16, the Examiner substantially repeats his prior arguments from the preceding Office Action, dated October 11, 2007. Presumably in response to the Appellants' arguments, the Examiner has dropped his assertion that one of ordinary skill in the art would be

motivated to modify the teachings of *Dhindsa* with those of *Demaray* and *Lieberman* by combining "an effect which yields a center low energy distribution with an effect that yields a center high energy distribution in order to obtain a resulting substantially flat uniform energy or power distribution." The Examiner replaces this reasoning with a merely conclusory statement that one of skill in the art would modify *Demary* and *Dhindsa* by "determining the desired energy distribution and selecting the proper conditions in order to form a resulting energy distribution from two frequencies with complementing energy distribution profiles because Leiberman teaches energy distributions are frequency dependant [sic]." (*Id.*, pp. 16-17.)

However, as discussed in the Appeal Brief, dated 03/10/08, none of the cited references, alone or in combination, teach, suggest, or otherwise yield determining a desired energy distribution of the plasma and producing the desired energy distribution through a controlled interaction between a first and a second RF signal applied to a first electrode disposed in a processing chamber, as recited in claim 34, or supplying a first RF signal at a first power level to a first electrode disposed in an etch chamber and controlling the application of a second RF signal at a second power level to the first electrode to produce a desired power distribution in the plasma, as recited in claim 37.

Further, and as also discussed in the Appeal Brief, dated 03/10/2008, *Demaray* fails to disclose any mechanism for producing a desired energy distribution in a plasma through a controlled interaction between a first and a second RF signal applied to a first electrode, as recited in claim 34. Further, *Demaray* fails to teach, suggest, or otherwise yield supplying a first RF signal at a first power level…..and controlling the application of a second RF signal at a second power level….to produce a desired power distribution in a plasma, as recited in claim 37.

Lastly, as discussed in the Appeal Brief, dated 03/10/08, although *Lieberman* provides examples of energy distributions formed from 13.56 and 40.7 MHz signals, *Lieberman* fails to teach or suggest what any resultant energy distribution would be for any combination of frequencies applied to a single electrode. Accordingly, *Lieberman* fails to teach, suggest, or otherwise yield the specific modification proposed by the Examiner. As such, a *prima facie* case of obviousness has not been established as the combination of the cited references fails to yield the limitations recited in the claims.

Thus, the Appellants submit that claims 34-35 and 37-39 are patentable over *Dhindsa* in view of *Demaray* and *Lieberman*. Accordingly, the Appellants respectfully request that the rejection be withdrawn and the claims allowed.

7. 35 USC §103 Claim 36

The Appellants note that the Grounds for Rejection and Response to Arguments sections of the Examiner's Answer regarding claim 36 are substantively identical to those of the prior Examiner's Answer dated April 18, 2008 with the exception that the Examiner has made the rejection in view of *Dhindsa* and *Lieberman* as applied to claim 34 and further in view of *Georgieva* and *Demaray*, as compared to *Dhindsa*, *Lieberman*, and *Demaray* as applied to claim 34 and further in view of *Georgieva*,as recited in the Examiner's Answer dated April 18, 2008. Thus, the Appellants' reply regarding claim 36 is substantively identical to the reply provided in the Reply Brief dated June 18, 2008.

In the Response to Arguments section of the Examiner's Answer, page 17, the Examiner essentially ignores the arguments presented by Appellants and merely asserts that "one skilled in the art should be able to choose any combination of frequencies in the range from about 2 to 40.7 MHz as illustrated by Demaray, Dindsa and Leiberman and discussed above."

However, the Examiner does not address why or how one of ordinary skill in the art at the time of the invention would modify or combine the cited art in a manner that would yield the limitations recited in the claims, given that each reference discloses providing a specific set of frequencies by a dual frequency power source – *Dhindsa* (2 MHz and 27 MHz), *Georgieva* (27 MHz and 2 MHz), Demaray (13.56 MHz and 100-400 KHz) and *Lieberman* (13.56 MHz and 40.7 MHz) – and that no combination of the cited references teaches, suggests, or otherwise yields applying about a 2 MHz frequency and about a 13.56 MHz frequency from a first and second RF source, respectively, to a first electrode, as recited in claim 36.

The Examiner further does not address the Appellants argument that only results effective variables may be said to be optimizable through routine experimentation, (*MPEP* §2144.05(II)(B).), and that, here, there is no teaching or suggestion that the particular frequencies as recited in the claims are results effective variables. Moreover,

as the controlling mechanism recited in the claims is an interaction between the two frequencies (which is further not taught, suggested, or otherwise yielded by the cited art), it has further not been shown that an interaction between the two frequencies is an art-recognized variable that may by optimized through routine experimentation.

Therefore, a *prima facie* case of obviousness has not been established as the combination of the cited references fails to yield first determining a desired energy distribution of the plasma and then producing the desired energy distribution through a controlled interaction between a first and a second RF signal applied to a first electrode disposed in a processing chamber, wherein the first RF signal has a frequency of about 2 MHz and the second RF signal has a frequency of about 13.56 MHz as recited in claim 36.

Thus, the Appellants submit that claim 36 is patentable over *Dhindsa* in view of *Lieberman*, *Georgieva*, and *Demaray*. Accordingly, the Appellants respectfully request that the rejection be withdrawn and the claim allowed.

8. 35 USC §103 Claims 43-46

The Appellants note that the Grounds for Rejection and Response to Arguments sections of the Examiner's Answer regarding claims 43-46 are substantively identical to those of the prior Examiner's Answer dated April 18, 2008, with the exception that the Examiner has made the rejection in view of *Dhindsa* and *Lieberman*. In the Examiner's Answer dated April 18, 2008, the rejection was in view of *Dhindsa*, *Lieberman*, and *Demaray*. However, in view of the confusion surrounding the grounds for rejection of independent claims 34 and 37, from which claims 43-46 depend, the Appellants' arguments below are made in view of the Examiner's present arguments regarding independent 34 and 37 made in the Examiner's Answer dated December 31, 2008. Thus, the Appellants' arguments address *Demaray* as it applies to claims 43-46 in view of independent claims 34 and 37.

In the Response to Arguments section of the Examiner's Answer, page 17, the Examiner merely conclusorily adds that "one who is skilled in the art should be able to employ other combination [sic] of dual frequencies for plasma etching."

However, as addressed above in the rejections of claims 34 and 37 (from which the above rejected claims directly or indirectly depend), the mere fact that infinite combinations of frequencies may be theoretically utilized in a process (whether they ultimately work for any particular purpose or not) is insufficient to teach, suggest, or otherwise yield a particular set of frequencies for a particular process.

Independent claims 34 and 37, from which claims 43-46 respectively depend, each recite limitations not obtainable by the combination of the cited art. The patentability of claims 34 and 37 over *Dhindsa* in view of *Lieberman* (and *Demaray*) has been discussed above. Specifically, the combination of *Dhindsa* and *Lieberman* (or *Dhindsa*, *Lieberman* and *Demaray*) fails to teach, suggest, or otherwise yield determining a desired energy distribution of the plasma and producing the desired energy distribution through a controlled interaction between a first and a second RF signal applied to a first electrode disposed in a processing chamber, as recited in claim 34, or supplying a first RF signal at a first power level to a first electrode disposed in an etch chamber and controlling the application of a second RF signal at a second power level to the first electrode to produce a desired power distribution in the plasma, as recited in claim 37. As such, a *prima facie* case of obviousness has not been established as the combination of the cited references fails to yield the limitations recited in the claims.

Thus, the Appellants submit that claims 43-46 are patentable over *Dhindsa*, in view of *Lieberman* and *Demaray*. Accordingly, the Appellants respectfully request that the rejection be withdrawn and the claims allowed.

CONCLUSION

For the reasons advanced above, Appellants respectfully urge that the rejections of claims 1-14 and 33-46 as being unpatentable under 35 U.S.C. §103 are improper. Reversal of the rejections in this appeal is respectfully requested.

Respectfully submitted,

March 2, 2009

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CLAIMS APPENDIX

1. (Previously Presented) A method of controlling characteristics of a plasma in a semiconductor substrate etch processing chamber using a dual frequency RF source, comprising:

supplying a first RF signal to a first electrode disposed in an etch chamber; and

supplying a second RF signal to the first electrode, wherein an interaction between the first and second RF signals is used to control at least one characteristic of a plasma formed in the etch chamber.

2. (Original) The method of claim 1, wherein the plasma characteristic is at least sheath modulation.

3. (Original) The method of claim 2, wherein the first and second RF signals are of a low enough frequency to provide a strong self-biasing sheath in the plasma.

4. (Original) The method of claim 2, wherein the first RF signal provides a broad ion energy distribution and the second RF signal provides a peaked, well defined ion energy distribution.

5. (Original) The method of claim 4, wherein the first RF signal has a cycle time that is larger than the transit time of an ion in the sheath, and wherein the second RF signal has a period that is nearly equal to or greater than the transit time of an ion in the sheath.

6. (Original) The method of claim 2, wherein the combined applied voltage of the first and second RF signal is used to control a peak-to-peak sheath voltage and a self-biased DC potential.

7. (Original) The method of claim 6, wherein the interaction between the first and second RF signals is a ratio of their applied power.

8. (Original) The method of claim 7, wherein the ratio is used to tune the energy distribution about an average acceleration generated by the DC potential.

9. (Original) The method of claim 1, further comprising:
supplying a third RF signal to a second electrode to form the plasma.

10. (Original) The method of claim 1, wherein the plasma characteristic is at least a power distribution within the plasma.

11. (Original) The method of claim 10, wherein the first and second RF signals provide similar plasma excitation properties and different spatial uniformity profiles.

12. (Original) The method of claim 11, wherein the interaction between the first and second RF signals is a varying effect on the power distribution in the plasma.

13. (Original) The method of claim 12, wherein the first and the second RF signals are selected such that a combined effect of the first and second RF signals produces a substantially flat power distribution.

14. (Original) The method of claim 12, wherein the interaction between the first and second RF signals is used to control the uniformity of a plasma enhanced etch process.

33. (Previously Presented) The method of claim 1, wherein the first RF signal has a frequency of about 2 MHz and the second RF signal has a frequency of about 13.56 MHz.

34. (Previously Presented) A method of controlling characteristics of a plasma in a semiconductor substrate etch chamber using a dual frequency RF source, comprising:
determining a desired energy distribution of the plasma; and

producing the desired energy distribution through a controlled interaction between a first and a second RF signal applied to a first electrode disposed in an etch chamber.

35. (Previously Presented) The method of claim 34, wherein the producing step further comprises:

supplying the first RF signal at a first power level; and

supplying the second RF signal at a second power level, the second power level at a predetermined ratio of the first RF signal.

36. (Previously Presented) The method of claim 34, wherein the first RF signal has a frequency of about 2 MHz and the second RF signal has a frequency of about 13.56 MHz.

37. (Previously Presented) A method of controlling characteristics of a plasma in a semiconductor substrate etch chamber using a dual frequency RF source, comprising:

supplying a first RF signal at a first power level to a first electrode disposed in an etch chamber; and

controlling the application of a second RF signal at a second power level to the first electrode to produce a desired power distribution in the plasma.

38. (Previously Presented) The method of claim 37, wherein the desired power distribution is substantially flat.

39. (Previously Presented) The method of claim 37, further comprising:

etching a substrate using the plasma having the desired power distribution.

40. (Previously Presented) The method of claim 1, wherein the first electrode is disposed beneath a substrate support surface in the etch chamber.

41. (Previously Presented) The method of claim 40, wherein the electrode is a cathode.

42. (Previously Presented) The method of claim 40, further comprising:
etching a substrate disposed on the substrate support surface.

43. (Previously Presented) The method of claim 34, wherein the first electrode is disposed beneath a substrate support surface in the etch chamber.

44. (Previously Presented) The method of claim 43, further comprising:
etching a substrate disposed on the substrate support surface.

45. (Previously Presented) The method of claim 37, wherein the first electrode is disposed beneath a substrate support surface in the etch chamber.

46 (Previously Presented) The method of claim 45, further comprising:
etching a substrate disposed on the substrate support surface.

EVIDENCE APPENDIX

[NONE]

RELATED PROCEEDINGS APPENDIX

[NONE]